

MEMO

To: Anton Dainty, Robert Woodward, Robert North, Roger Bowman

From: K. L. McLaughlin – Group 2 Consortium PI

Subject: SSSC depth dependence

CC: Paul Richards, and Jack Murphy, Group 2 Consortium

Date: Tuesday, April 18, 2000

At the DTRA April 17th Location Calibration Kickoff meeting the three consortium PI's were asked to draft letters of recommendation (and or requirements) for SSSC depth dependence. The DTRA PRDA directed performers to deliver depth dependent SSSCs and we understand all respective Statements Of Work reflect this requirement. Each consortium has proposed a different schedule to deliver SSSCs over the next 36 months.

IDC software does not presently have the capability to utilize depth dependent SSSCs. In fact, the current implementation applies the source-specific corrections at all source depths. Corrections have only been implemented for Pn, Pg, Sn, & Lg at stations in North America and Fennoscandia where seismicity is strictly crustal. Corrections for Pn are not applied to pPn.

Our Group 2 consortium, plans to deliver "shallow source" only SSSCs to the CMR R&D Testbed in June 2001 consistent with our proposal. We will have already performed offline testing on a series of validation data sets and we will have prepared a Test Plan and delivered one or more validation Ground Truth (GT) datasets for use on the R&D Testbed by June 2001. We currently have scheduled 3-4 months for 1) installation of SSSCs & GT data sets, 2) repeated test runs, 3) documentation of test results, and 4) drafting a CCB proposal. This should be completed in September-October 2001. Provided some set (or subset) of SSSCs pass the CCB they could be available for PIDC-IDC Release 4 (R4) or an R4 patch. Some aspects of this schedule are flexible, however, given the many tasks that must be accomplished by our consortium, we cannot expect to make a delivery of the initial SSSCs to the R&D Testbed any earlier than June 2001. If CMR R&D Testbed wishes to schedule more time for installation, testing, and documentation, we will understand. Members of our consortium have had experience producing the necessary files, and preparing GT data for validation, so I expect minimal delays. A more complete set of SSSCs including depth dependence will be delivered in late 2002 for testing.

Our consortium is faced with several critical design decisions that will affect our strategies for SSSC production in the next 12 months. We recognize it is highly unlikely that full SSSC depth dependence can be implemented in any R4 release. However, we recognize any future design decisions regarding libloc/EvLoc/LocSat affect our work.

First, we must choose a “shallow depth” for our initial SSSCs. Since the current SSSC implementation applies corrections to all source depths, we will probably choose compromise depth(s) for all regions of crustal seismicity. This strategy would be consistent with SSSCs already implemented for Fennoscandia and North America. These previous SSSCs ignored lateral variations in low velocity sedimentary cover. We justified this given that 1) the vast majority of earthquakes occur in the “basement” below low velocity sediments, and 2) travel time corrections for low velocity sedimentary cover are nearly the same for all stations and corrections trade off with origin time.

Second, we must choose a strategy for dealing with zones of subcrustal & deep seismicity in the Mediterranean, Romania, Spain, & Iran. If we are not able to “turn-off” SSSCs below a specified depth, we may be forced to “cut-out” these zones in order to avoid undesirable side effects. This would be unfortunate and limit the applicability of the SSSCs. One option that would allow us to construct SSSCs for shallow events over regions of deeper seismicity is to specify a maximum cut-off depth. This may be a simpler temporary fix to the IDC software that could be implemented for R4. Obviously, in order to make use of this option, we would need to have a pre-release version of EvLoc/LocSat in order to perform offline unit testing in the second quarter of 2001. We have limited resources to pursue both strategies.

In the end, however, the Group 2 consortium will require some form of SSSC depth dependence for offline unit testing in the first quarter of 2002. At present we do not know how many depth intervals will be required, or their density. However, it is reasonable to project we will need between 5 and 10 in some limited regions, and between 1 and 5 in larger regions. It is also probable that many regions will be adequately covered with a single “compromise” depth. We can expect grids of between 0.5 x 0.5 and 1 x 1 degree between 0 and 20 degrees of each station for Pn, Sn, & Lg. Pg grids have previously been generated only out to 8 degrees.

A more general long-term approach to SSSCs must seriously be considered. IDC software uses both regional and teleseismic arrivals in locating events with a general inverse *a-priori* variance weighting scheme. The obvious extension to regional SSSCs is teleseismic SSSCs. Also, once we have admitted depth dependence for direct arrivals, we must model the dependence on depth phases (pPn, sPn, pP, sP, pPcP, sPcP,...) for consistency. The profusion of tables for each station will soon become large. We suggest we consider 1) a short-term fix (such as the one suggested above) for R4 by 2001, 2) changes to support limited regions of subcrustal seismicity covered by the Group 1 & 2 Consortia by 2002, and 3) a longer term approach (2003-2004) that will allow incorporation of the inevitable set of regional and teleseismic travel time curves.